

# Lifesaving after cardiac arrest due to drowning

## - Characteristics and outcome

Akademisk avhandling

som för avläggande av medicine doktorexamen vid Sahlgrenska Akademin vid Göteborgs Universitet  
offentligen kommer att försvaras i Sahlgrenska aula, Sahlgrenska Universitetssjukhuset Fredagen den 20:e  
September 2013 klockan 13:00

av

**Andreas Claesson**

Specialistsjuksköterska inom ambulanssjukvård

Fakultetsopponent:  
Professor Hans-Morten Lossius  
Universitetet i Stavanger  
Institutt for Helsefag, Stavanger Norge

This thesis is based on the following papers, referred to in the text by their Roman numerals:

- I. Claesson A, Svensson L, Silfverstolpe J, Herlitz J. Characteristics and outcome among patients suffering out-of-hospital cardiac arrest due to drowning. Resuscitation. 2008 Mar;76(3):381-7
- II. Claesson A, Karlsson T, Thorén AB, Herlitz J. Delay and performance of cardiopulmonary resuscitation in surf lifeguards after simulated cardiac arrest due to drowning. Am J Emerg Med. 2011 Nov;29(9):1044-50.
- III. Claesson A, Lindqvist J, Ortenwall P, Herlitz J. Characteristics of lifesaving from drowning as reported by the Swedish Fire and Rescue Services 1996-2010. Resuscitation. 2012 Sep;83(9):1072-7
- IV. Claesson A, Druid H, Lindqvist J, Herlitz J. Cardiac disease and probable intent after drowning. Am J Emerg Med. 2013 Jul;31(7):1073-7. doi: 10.1016/j.ajem.2013.04.004. Epub 2013 May 20.
- V. Claesson A, Lindqvist J, Herlitz J. Cardiac arrest due to drowning: Changes over time and factors of importance for survival. Submitted

Permission to reproduce and use content from the above articles was obtained from the publisher



UNIVERSITY OF GOTHENBURG

Gothenburg 2013

# Lifesaving after cardiac arrest due to drowning

## - Characteristics and outcome

**Andreas Claesson**

Department of Molecular and Clinical Medicine/Cardiology, Institute of Medicine  
Sahlgrenska Academy at the University of Gothenburg, Sweden, 2013.

### **Abstract**

**Aims:** The aim of this thesis was to describe out-of-hospital cardiac arrest (OHCA) due to drowning from the following angles. In Paper I: To describe the characteristics of OHCA due to drowning and evaluate factors of importance for survival. In Paper II: To describe lifesaving skills and CPR competence among surf lifeguards. In Paper III: To describe the characteristics of interventions performed by the Swedish fire and rescue services (SFARS) and evaluate survival with or without rescue diving units. In Paper IV: To describe the prevalence of possible confounders for death due to drowning. In Paper V: To describe changes in characteristics and survival over time and again to evaluate factors of importance for survival

**Methods:** Papers I and III-V are based on retrospective register data from the Swedish OHCA Register reported by Emergency Medical Service (EMS) clinicians between 1990-2011. In addition, in Paper III, the data have been analysed and compared with the SFARS database for rescue characteristics. In Paper IV, the data have been compared with those of the National Board of Forensic Medicine (NBFM). Paper II is a descriptive study of 40 surf lifeguards evaluating delay and CPR quality as performed on a manikin.

**Results:** Survival in OHCA due to drowning is about 10% and does not differ significantly from OHCA with a cardiac aetiology. The proportion of witnessed cases was low. Survival appears to increase with a short EMS response time, i.e. early advanced life support. Surf lifeguards perform CPR with sustained high quality, independent of prior physical strain. In half of about 7,000 drowning calls, there was need for a water rescue by the fire and rescue services. Among the OHCA in which CPR was initiated, a majority were found floating on the surface. Rescue diving took place in a small percentage of all cases. Survival when using rescue divers did not differ significantly from drownings where rescue diving units were not used. No survivors were found after >15 minutes of submersion in warm water. After submersion in cold water, survival with a good neurological outcome was extended. Among 2,166 autopsied cases of drowning, more than half were judged as accidents and about one third as intentional suicide cases. Among accidents, 14% were found to have a cardiac aetiology, while the corresponding figure among suicides was 0%. In a 20-year follow-up of OHCA due to drowning in Sweden, both bystander CPR and early survival to hospital admission are increasing. The proportion of cases alive after one month has not changed significantly during the period.

**Conclusions:** Survival from OHCA due to drowning is low. A reduction in the EMS response time appears to have high priority, i.e. early ALS is important. The quality of CPR among surf lifeguards appear to be high and not affected by prior physical strain. In all treated OHCA cases, the majority were found at the surface and survival when rescue diving took place did not appear to be poorer than in non-rescue diving cases. In a minor proportion of cases, cardiac disease could be a confounder for death due to drowning. Bystander CPR in OHCA due to drowning has increased over a 20-year period and the proportion of early survivors to hospital admission is increasing. We speculate that our studies were underpowered with regard to the opportunity adequately to assess the effects of bystander CPR on survival to hospital discharge. A uniform Swedish definition of drowning based on the recommended international terms should be implemented throughout Swedish authorities and health care, in order to enhance the quality of data and improve the potential for future research.

**Keywords:** Drowning, Cardiac arrest, CPR, Lifesaving

**ISBN:** 978-91-628-8724-7